

PRODUCT DATA

Piezoelectric Accelerometer Miniature Triaxial DeltaTron[®] Accelerometers — Types 4524, 4524 B

Types 4524 and 4524B are lightweight triaxial piezoelectric OrthoShear[®] accelerometers, each with three independent outputs for simultaneous measurements in three mutually perpendicular directions. Types 4524 and 4524B have a 4-pin connector.

The clip mounting facility combined with the ability to mount the transducer on five of its six surfaces makes mounting on structures very flexible and quick and thus ideal for structural and modal analysis measurements.

The light compact construction is an improved design covered by the OrthoShear patent.



USES AND FEATURES

USES

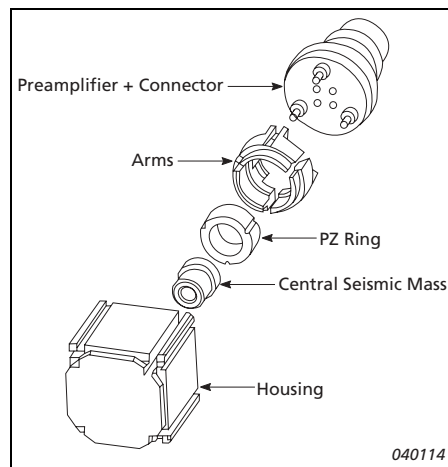
- Structural analysis measurements
- Multichannel modal analysis measurements
- Modal measurements for automotive body and power-train applications

FEATURES

- High sensitivity-to-weight ratio
- Light weight (<5 gram)
- Excellent low-frequency response
- Electrically insulated
- Hermetically sealed
- Easy mounting on five of six surfaces

Characteristics

Fig. 1
Exploded view of Type
4524



The piezoelectric accelerometer features a built-in preamplifier. The sensitivity is expressed in terms of voltage per unit acceleration (mV/g).

The OrthoShear design used in Type 4524 (see Fig. 1) is built around a common seismic mass. This uni-mass design results in a very compact triaxial accelerometer where all the axes have the same point of reference. The design also ensures accurate and consistent measurements, even when the accelerometer is exposed to complex vibration patterns. The seismic mass is surrounded by a piezoelectric ring, which is surrounded by three individually suspended, curved arms. Because of the suspension pins, different sections are exposed to shear forces for different directions of acceleration. By appropriate summation of the signals, the outputs for the X-, Y- and Z-axes are obtained.

Versions

Type 4524 B includes Transducer Electronic Data Sheet (TEDS), which contains sensor specific and application specific information, including frequency response compensation.

Mounting

Special effort has been put into making mounting as flexible as possible. The accelerometer housing has slots that allow the use of mounting clips. The accelerometers can be easily fitted to or removed from a number of different test objects.

In addition to adhesive mounting directly on the test specimen, there are four clip-mounting possibilities:

- A high-temperature mounting clip
- A thin, polycarbonate mounting clip for use on plane surfaces
- A mounting clip with thick base can be modified, before use, to suit the mounting surface on the test object
- A mounting clip with swivel base and a spirit level which makes it easy to align the accelerometer in order to retain the coordinate system

Fig. 2

High-temperature Mounting Clip UA 1564

Specifications:

Temperature range:

Maximum acceleration

(with a 5 gram accelerator):

(Perpendicular to mounting surface):

Base Material:

Spring Material:

Weight:

Full operating range of Type 4524

50 g peak

250 g peak

Anodised aluminium

Stainless spring steel

5.7 gram



Fig. 3

Mounting Clip UA 1407

Specifications:

Upper limiting frequency, 10%

- X-axis: 2.7 kHz

- Y- and Z-axes: 2.0 kHz

Weight: 0.4 gram

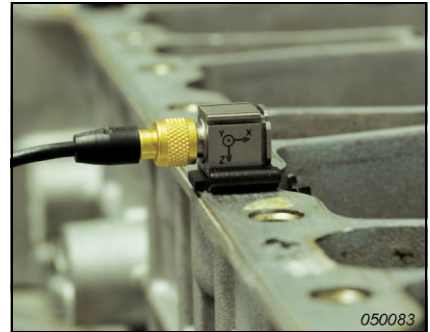
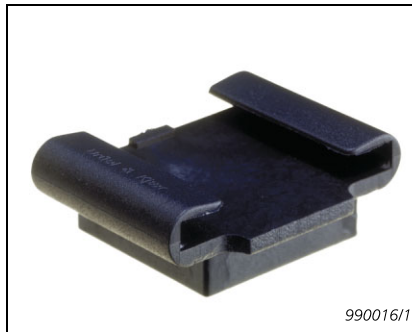


Fig. 4

Mounting Clip with Thick Base UA 1475

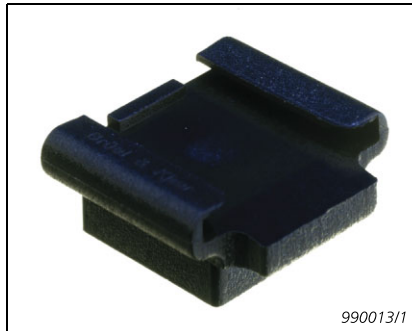
Specifications:

Upper limiting frequency (10%)

- X-axis: 2.7 kHz

- Y- and Z-axes: 2.0 kHz

Weight: 0.7 gram



Common Specifications for all Plastic Mounting Clips (UA 1407, UA 1475, UA 1478)

Temperature range:

(For brief use, <1 hour):

(Perpendicular to mounting surface):

Material:

-54° to +50°C (-65° to +122°F)

-54° to +80°C (-65° to +176°F)

10 g peak

70 g peak

Glass-reinforced polycarbonate

Fig. 5

Swivel Base UA 1478

Specifications:

Excitation must be along one of the accelerometer's axes of sensitivity but with mounting surface of the hemispherical part at 45° to the direction of the excitation:

- X-axis: 2.5 kHz

- Y- and Z-axes: 1.9 kHz

Weight: 0.8 gram



Fig. 6

Spirit Level UA 1480

Specifications:

Max. dimensions: 85 × 23 × 17 mm

Material: Black, anodised aluminium



Calibration

Fig. 7

Calibration Clip DV 0459

Specifications:

Mounting-surface diameter:

Mounting thread:

Base Material:

Spring Material:

Weight:

21 mm

10–32 UNF

Stainless steel (hardened):

Stainless steel spring

17 gram



The transducers are individually calibrated and supplied with a comprehensive calibration chart, using state-of-the-art, random FFT technology, providing an 800-point high-resolution calibration (magnitude and phase) ultimately giving a unique characterization and securing the integrity of the vibration measurement.

The sensitivity given on the calibration chart has been measured at 159.2 Hz with a 95% confidence level, using a coverage factor $k = 2$.

Frequency Compensation

Increased measurement accuracy can be achieved by dividing the actual measurement by the individual frequency response.

Frequency response curves generated from the individual TEDS values are given on the calibration chart for the major part of the frequency range. At low frequencies, the curves given are typical (Fig. 8).

The calibration chart also includes these individual TEDS values that, together with a general formula, best fit the measured frequency response. The expression can be used for frequency

response compensation in the specified frequency range. The relative frequency response, including amplitude and phase, is:

$$S_{rel}(f, T) = (Sign) \times (1 + b(T - T_{ref})) \times \frac{j \frac{f}{f_{hp}}}{\left(1 + j \frac{f}{f_{hp}}\right)} \times \frac{1}{\left(1 + j \frac{f}{f_{lp}}\right)} \times \frac{1}{\left(1 + \left(j \frac{f}{f_{res}}\right)^2 + j \frac{f}{Q f_{res}}\right)} \times \left(j \frac{f}{f_{ref}}\right)^{\frac{a}{\ln 10}}$$

$Sign$ = Polarity

T = Temperature

f = Frequency

f_{lp} = Low-pass Cut-off Frequency

f_{ref} = Reference Frequency

a = Amplitude Slope/Decade

b = Temperature Coefficient

T_{ref} = Reference Temperature

f_{hp} = High-pass Cut-off Frequency

f_{res} = Resonance Frequency

Q = Quality Factor

Combining this equation with the amplitude sensitivity S_{ref} and f_{ref} and T_{ref} we have:

$$S(f, T) = S_{ref} \times \frac{S_{rel}(f, T)}{|S_{rel}(f_{ref}, T_{ref})|}$$

Implementation of this formula in either real-time data acquisition systems or in post-processing will support an automatic update of amplitude and/or phase.

Fig. 8
Typical amplitude response

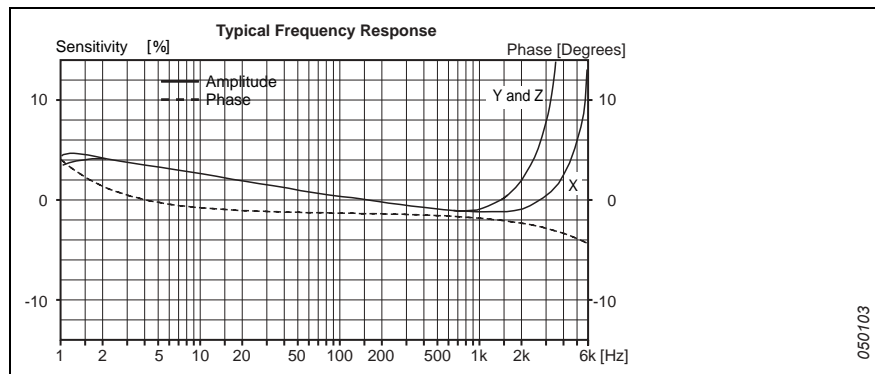
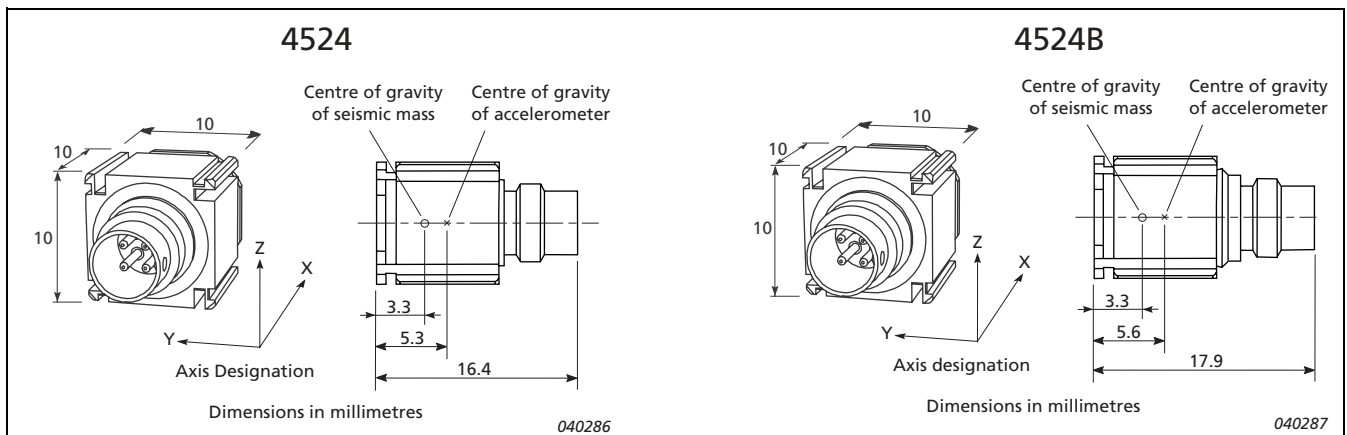


Fig. 9 Dimensions (millimetres) of Types 4524 and 4524B



DeltaTron Power Supply

Types 4524 and 4524 B require all three axes to be powered for operation. Single or dual axial supply is not possible. The accelerometers can be used with any constant current (2 to 10 mA) power supply setup.

For a cost-effective and reliable power supply, WB 1453 is a 3-channel, battery-operated power supply for DeltaTron accelerometers. The frequency range covers the full frequency range for the accelerometers and the transducer current is 3 mA \pm 20%. Both input and output are supplied with 4-pin, Microtech-compatible connectors.

Specifications – Miniature Triaxial DeltaTron Accelerometers Types 4524, 4524 B

	Units	4524	4524 B
Dynamic Characteristics			
Voltage Sensitivity (@ 159.2 Hz)	mV/ms ⁻² (mV/g)	10 \pm 5% (100 ⁺³ ₋₇ %)	
Measuring Range	ms ⁻² (g)	\pm 500 (\pm 50)	
Frequency Response		See typical Amplitude Response (Fig. 8)	
Mounted Resonance Frequency	kHz	x: 18 y: 9 z: 9	
Amplitude Response \pm 10%	Hz	x: 0.2 to 5500	y: 0.25 to 3000 z: 0.25 to 3000
Phase Response \pm 5°	Hz	1.5 to 3000	
Temperature Response	%/°C (%/°F)	0.14 (0.08)	
Residual Noise (1 to 6000 Hz)	mg	x: < 0.4	y: < 0.2 z: < 0.2
Transverse Sensitivity	%	< 5	
Electrical Characteristics			
DC Output Bias Voltage	V DC	+12 \pm 1	+13 \pm 1
Output Impedance	Ω	< 2	< 30
Grounding		Insulated from case	
Power Requirements Note: All three axes must be powered during operation			
Supply Voltage	V DC	24 to 30	
Supply Current	mA	2 to 10	
Warm-up Time (90% of stabilised bias)	s	10	
Environmental Characteristics			
Temperature Range	°C (°F)	-54 to +100 (-65 to +212)	
Humidity		Hermetic	
Max. Operational Sinusoidal Vibration (peak)	ms ⁻² (g)	5000 (500)	
Max. Operational Shock (\pm peak)	ms ⁻² (g)	50000 (5000)	
Base Strain Sensitivity	Equiv. ms ⁻² / μ strain (g/ μ strain)	Mounted in clip: 0.0005 (0.00005) Cemented to measuring object: 0.02 (0.002)	
Thermal Transient Sensitivity	Equiv. ms ⁻² /°C (g/°F)	0.004 (0.002)	
Magnetic Sensitivity (50 Hz–0.03 Tesla)	ms ⁻² /T (g/T)	20 (2)	
Physical Characteristics			
Dimensions		See outline drawing (Fig. 9)	
Weight	gram (oz.)	4.4 (0.15)	4.8 (0.17)
Case Material		Titanium	
Connector		Hermetic 4-pin receptacle ¼–28 UNF-2A	
Mounting		Adhesive or clip	

All values are typical at 25°C (77°F) unless measurement uncertainty is specified
All values are valid with 4 mA supply current and all three axes powered

COMPLIANCE WITH STANDARDS



Compliance with EMC Directive and Low Voltage Directive of the EU



Compliance with the EMC requirements of Australia and New Zealand

Ordering Information

ACCESSORIES INCLUDED

- Carrying Box
- Calibration Chart
- One Mounting Clip

OPTIONAL ACCESSORIES

AO 0526	Cable with 4-pin to 3 × BNC connectors, 5 m (16 ft), 85°C (185°F)
AO 0527	Cable with 4-pin to 3 × 10–32 UNF connectors, 5 m (16 ft), 85°C (185°F)
AO 0528	Cable with 4-pin to 4-pin connectors, 5 m (16 ft), 85°C (185°F)
AO 0534	Cable with 4-pin to 3 × BNC connectors, 5 m (16 ft), 120°C (248°F)
AO 0536	Cable with 37-pin D-range sub-connector to 2 × 4-pin, 10 m (33 ft), 85°C (185°F)
DV 0459	Calibration Clip
JJ 0425	4-pin Cable Extension Adaptor
UA 1407	Set of 100 Mounting Clips
UA 1418	Set of 25 Dummy Accelerometers for mass loading
UA 1475	Set of 100 Mounting Clips with thick base
UA 1478	Set of 100 Swivel Base Clips
UA 1480	Spirit Level Set (including 100 Swivel Base Clips)
UA 1564	Set of 5 High-temperature Mounting Clips
WB 1453	DeltaTron Power Supply
YJ 0216	Mounting Wax

SERVICE

4524-CAF	Triaxial IEPE Piezoelectric Accelerometer, Accredited Calibration
4524-CAI	Triaxial IEPE Piezoelectric Accelerometer, Accredited Calibration Performed as initial
4524-CTF	Triaxial IEPE Piezoelectric Accelerometer, Traceable Calibration
4524-CTI	Triaxial IEPE Piezoelectric Accelerometer, Traceable Calibration Performed as initial
4524-EW1	Triaxial IEPE Piezoelectric Accelerometer, Extended Warranty, one year extension
4524-B-CAF	Triaxial IEPE Piezoelectric Accelerometer, Accredited Calibration incl. Programming of TEDS
4524-B-CAI	Triaxial IEPE Piezoelectric Accelerometer, Accredited Calibration Performed as initial incl. Programming of TEDS
4524-B-CTF	Triaxial IEPE Piezoelectric Accelerometer, Traceable Calibration, incl. Programming of TEDS
4524-B-CTI	Triaxial IEPE Piezoelectric Accelerometer, Traceable Calibration Performed as initial, incl. Programming of TEDS
4524-B-EW1	Triaxial IEPE Piezoelectric Accelerometer, Extended Warranty, one year extension

Brüel & Kjær reserves the right to change specifications and accessories without notice

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